Appendix D: Federal Life-Cycle Costing Procedures and the BLCC Software

Federal agencies are required to evaluate energy-related investments on the basis of minimum life-cycle costs (LCC) (10 CFR Part 436). A life-cycle cost evaluation computes the total long-run costs of a number of potential actions, and selects the action that minimizes the long-run costs. When considering retrofits, sticking with the existing equipment is one potential action, often called the baseline condition. The LCC of a potential investment is the present value of all of the costs associated with the investment over time.

The first step in calculating the LCC is to identify the costs. Installed Cost includes cost of materials purchased and the labor required to install them (for example, the price of an energy-efficient lighting fixture, plus cost of labor to install it). Energy cost includes annual expenditures on energy to operate equipment. (For example, a lighting fixture that draws 100 watts and operates 2,000 hours annually requires 200,000 watt-hours [200 kWh] annually. At an electricity price of $0.10/kWh, this fixture has an annual energy cost of $20.) Non-fuel Operation and Maintenance (O&M) includes annual expenditures on parts and activities required to operate equipment (for example, replacing burned-out lightbulbs). Replacement costs include expenditures to replace equipment upon failure (for example, replacing an oil furnace when it is no longer usable).

Because LCC includes the cost of money, periodic and non-periodic O&M and equipment replacement costs, energy escalation rates, and salvage value, it is usually expressed as a present value, which is evaluated by

$$LCC = PV (IC) + PV(EC) + PV (OM) + PV (REP)$$

where PV (x) denotes "present value of cost stream x",

> IC is the installed cost,
>
> EC is the annual energy cost,
>
> OM is the annual non-energy cost, and
>
> REP is the future replacement cost.

Net present value (NPV) is the difference between the LCCs of two investment alternatives, e.g., the LCC of an energy-saving or energy-cost reducing alternative and the LCC of the baseline equipment. If the alternative's LCC is less than baseline's LCC, the alternative is said to have NPV, i.e., it is cost effective. NPV is thus given by

$$NPV = PV(EC_0) - PV(EC_1) + PV(OM_0) - PV(OM_1) + PV(REP_0) - PV(REP_1) - PV (IC)$$

or

$$NPV = PV(ECS) + PV (OMS) + PV(REPS) - PV (IC)$$

where subscript 0 denotes the baseline condition,

> subscript 1 denotes the energy cost-saving measure,
>
> IC is the installation cost of the alternative (the IC of the baseline is assumed to be zero),
>
> ECS is the annual energy cost saving,
>
> OMS is the annual non-energy O&M saving, and
>
> REPS is the future replacement saving.

Levelized energy cost (LEC) is the break-even energy price (blended) at which a conservation, efficiency, renewable, or fuel-switching measure becomes cost effective (NPV $\geq$ 0). Thus, a project's LEC is given by

$$PV(LEC*EUS) = PV(OMS) + PV(REPS) - PV(IC)$$

where EUS is the annual energy use savings (energy units/year). Savings-to-investment ratio (SIR) is the total (PV) saving of a measure divided by its installation cost:

$$SIR = (PV(ECS) + PV(OMS) + PV(REPS))/PV(IC)$$

Some of the tedious effort of LCC calculations can be avoided by using the BLCC software, developed by NIST. For copies of BLCC, call the FEMP Help Desk at (800) 363-3732.